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Typed Name: James E. Barlow.
Signature: Barlow

TRANSLATION OF JAPANESE PATENT APPLICATION 2002-345444

Sir:

Attached is an accurate translation of Japanese patent application 2002-345444, on which priority under section 35 USC 119 is based on the present application.

Respectfully submitted,

Barlow
James E. Barlow
Reg. No. 32,377

Posz Law Group, PLC
12040 South Lakes Drive, Suite 101
Reston, VA 20191
Phone 703-707-9110
Fax 703-707-9112
Customer No. 23400

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[Inventor]

[Address] c/o TOYODA GOSEI CO., LTD. 1, Aza-Nagahata, Oaza-Ochiai, Haruhi-cho, Nishikasugai-gun, Aichi-ken

[Name] Takayuki ITO

[Inventor]

[Address] c/o TOYODA GOSEI CO., LTD. 1, Aza-Nagahata, Oaza-Ochiai, Haruhi-cho, Nishikasugai-gun, Aichi-ken

[Name] Toshihiko ASAYA

[Inventor]

[Address] c/o TOYODA GOSEI CO., LTD. 1, Aza-Nagahata, Oaza-Ochiai, Haruhi-cho, Nishikasugai-gun, Aichi-ken

[Name] Norio OTANI

[Applicant for Patent Application]

[Registration Number] 000241463

[Name] TOYODA GOSEI CO., LTD.

[Agent]

[ID Number] 100068755

[Patent Attorney]

[Name] Hironori ONDA

[Appointed Agent]

[ID Number] 100105957

[Patent Attorney]

[Name] Makoto ONDA

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[Title of the Invention] METHOD FOR MANUFACTURING INSERT MOLD PRODUCT

[Scope of the Invention]

[Claim 1] A method for manufacturing an insert mold product using an insert molding process that covers at least a part of the outer surface of an insert member with a molding material, characterized by:

a machining process for machining the insert member; and a cleaning process for removing foreign matter on the insert member before the insert molding process, which foreign matter includes a machining aid used in the machining process and swarf created in the machining process.

[Claim 2] The method for manufacturing an insert mold product according to claim 1, characterized in that the insert molding process includes a coating forming process, in which, with the insert member set in a cavity of a mold, at least one of a solution containing the molding material and a solution containing a molding assistant is injected into the cavity, wherein the solution is boiled to form a coating on an inner wall surface of the cavity.

[Claim 3] The method for manufacturing an insert mold product according to claim 1 or 2, characterized in that the cleaning process includes contacting the insert member with a cleaning agent and removing the foreign matter.

[Claim 4] The method for manufacturing an insert mold product according to claim 3, characterized in that, after the cleaning process, a cleaning agent removing process performed for removing a cleaning agent adhered to the insert member.

[Claim 5] The method for manufacturing an insert mold product according to claim 3 or 4, characterized in that the cleaning process includes injecting the cleaning agent to the insert member.

[Claim 6] The method for manufacturing an insert mold product according to any one of claims 3 to 5, characterized in that the cleaning process includes using a cleaning apparatus that has a plurality of nozzles, wherein the nozzles are arranged substantially along an outer shape of the insert member, and injecting cleaning agent to the insert member.

[Claim 7] The method for manufacturing an insert mold product according to any one of claims 3 to 6, characterized in that the cleaning agent is contained in the machining aid used in the machining process and is a fluid containing a substance that dissolves, disperses, or adsorbs an adhesive component that causes the foreign matter to adhere to the insert member.

[Claim 8] The method for manufacturing an insert mold product according to claim 7, characterized in that the cleaning process includes injecting the cleaning agent to the insert member at a predetermined pressure.

[Claim 9] The method for manufacturing an insert mold product according to claim 7 or 8, characterized in that the cleaning agent is water when the machining aid has a high affinity for water.

[Claim 10] The method for manufacturing an insert mold product according to any one of claims 3 to 9, characterized in that the cleaning step includes using a cleaning agent that is heated to a temperature higher than an ordinary temperature.

[Claim 11] The method for manufacturing an insert mold product according to claim 10, characterized in that the cleaning agent is steam.

[Claim 12] The method for manufacturing an insert mold product according to any one of claims 1 to 11, characterized in that the insert member is a core of a vehicle steering wheel.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application]

The present invention relates to a method for manufacturing an insert mold product, which is molded with an insert member.

[0002]

[Prior Art]

Conventionally, as one of such insert mold products, for example, a steering wheel for a vehicle is known. A steering wheel has a core as an insert member. Mainly on the rim of the cored bar, a resin layer, for example, a urethane resin layer is formed. On the surface of the resin layer, a mold coating layer is formed. The mold coating layer consists of a surface protection material having light resistance, which is a so-called mold coating material. The mold coating layer is formed in a thin film, whose thickness is, for example, 5 µm.

[0003]

A steering wheel is typically manufactured, for example, through one of the following two methods.

In the first method, a material containing mold coating is applied to the inner wall surface of the cavity of an opened mold with, for example, a spray gun, thereby forming a mold coating layer. Thereafter, the mold is closed with a core located at a predetermined position in the mold. The urethane resin is injected into the cavity to perform a conventional insert molding. This forms a resin layer (The first conventional method).

[0004]

In the second method, a mold is closed with a core located at a predetermined position in the mold. Thereafter, inside the cavity is made a reduced-pressure atmosphere with a vacuum pump. While the pressure in the cavity is being lowered, a solution containing mold coating material is infused into the cavity to form a mold coating layer composed of a mold coating material on the inner wall surface of the cavity. Thereafter, the urethane resin is injected into the cavity is to perform a conventional insert molding, thereby forming the resin layer (for example, see Patent document 1).

[0005]

The core is traditionally made through, for example, casting. In this case, fins are created on the cast core. To remove the fins, the core is subjected to, for example, shot blasting. The core has threaded holes to fix, for example, an airbag apparatus and a horn switch. The threaded holes are formed through cutting. Shot blasting and cutting are performed prior to insert molding even if the fins and threaded holes are at an exposed position that are not covered by urethane resin.

[0006]

[Patent Document 1]

Japanese Laid-Open Patent Publication No. 2746024 (pages 3 to 5, Figs. 1 to 3)

[0007]

[Problems that the Invention is to solve]

When cutting the core, cutting lubricant is used. Swarf such as cutout pieces or powder of the fins generated in the shot blasting, and shavings generated in the cutting can adhere to the core by the adhesion of the cutting lubricant. If a core with adhered swarf is used for forming a steering wheel through one of the above listed conventional methods, the steering wheel will have the following drawbacks.

[0008]

In the first conventional method, when the core is located at the predetermined position in the mold, swarf adhered to the surface of the core can fall onto the mold coating layer on the inner wall surface of the cavity. If insert molding is performed with swarf on the mold coating layer, the manufactured steering wheel will have the swarf either between the resin layer and the mold coating layer or in the vicinity of the resin layer and the mold coating layer. In this way, if the swarf remains either between or in the vicinity of the resin layer and the mold coating layer of the steering wheel, the gripping feeling of the steering wheel for a driver of the vehicle will be deteriorated since the mold coating layer is very thin.

[0009]

In the second conventional method, when the core is located at the predetermined position in the mold, swarf adhered to the surface of the core can fall onto the inner wall surface of the cavity. When a solution containing mold coating material is infused into the cavity with swarf that has fallen onto the inner wall surface of the cavity, the swarf remains inside or on the surface of the mold coating layer which is formed after the infusion. Remaining swarf inside or on the surface of the mold coating layer degrades the feel of gripping of the steering wheel for the driver of the vehicle. Also, the remaining swarf can be seen on the surface of the steering wheel, which degrades the appearance of the steering wheel.

[0010]

The present invention was made for solving the above problems in the prior art. Accordingly, it is an objective of the present invention to provide a method for manufacturing an insert molding product, which method prevents degradation in the quality of the insert product.

[0011]

[Means for Solving the Problems]

In order to achieve the above objective, the invention according to claim 1 has a manufacturing method of an insert mold product having an insert molding process that covers at least a part of the outer surface of an insert member with a molding material. The manufacturing method has a machining process for machining the insert member and a cleaning process for removing foreign matter on the insert member before the insert molding process. The foreign matter includes machining aid used in the machining process and swarf created in the machining process.

[0012]

In the invention according to claim 1, even though foreign matter such as machining aid or swarf are adhered to the insert member in the machining process, the adhered foreign matter will be removed from the insert member in the cleaning process. This prevents foreign matter from remaining in the insert product after molding, and degradation in the quality of the insert product is avoided.

[0013]

In the invention according to claim 2, based on the invention according to claim 1, the insert molding process includes a coating forming process in which, with the insert member set in a cavity of a mold, at least one of a solution containing the molding material or a solution containing a molding assistant is injected into the cavity, wherein the injected solution is brought to a boil for forming a coating on the internal wall surface of the cavity.

[0014]

When the insert molding is performed using an insert member with foreign matter adhered to the outer surface, the foreign matter falls when the solution injected into the cavity is boiled and is apt to move onto the internal wall surface of the cavity. If the insert molding process is performed in this state, fallen foreign matter is apt to remain on the outer surface of or in the vicinity of the surface of the insert product, which degrades the appearance or feel of the insert product.

[0015]

In contrast, in the invention according to claim 2, in addition to the advantages of the invention according to claim 1, the insert molding process uses the insert member which is cleaned in the cleaning process. Therefore, even if an insert molding method that performs the coating forming process by boiling the solution is used, the degradation in the appearance and feel of the insert product is avoided.

[0016]

In the invention according to claim 3, based on the invention according to claim 1 or 2, the cleaning process removes the foreign matter by contacting the insert member with cleaning fluid.

[0017]

In the invention according to claim 3, in addition to the advantages of the invention according to claim 1 or 2, the foreign matter adhered to the insert member can be removed effectively.

[0018]

In the invention according to claim 4, based on the invention according to claim 3, the cleaning agent removing process is performed to remove the cleaning agent adhered to the insert member after the cleaning process.

[0019]

In the invention according to claim 4, in addition to the advantages of the invention according to claim 3, the cleaning process removes the cleaning agent adhered to the insert member in the cleaning agent removing process. Therefore, the quality of the cleaned insert product is not affected.

[0020]

In the invention according to claim 5, based on the invention according to claim 3 or 4, the cleaning process includes injecting the cleaning agent to the insert member.

[0021]

In the invention according to claim 5, in addition to the advantages of the invention according to claim 3 or 4, when the insert member is cleaned in the cleaning process, the injected cleaning agent collides aging the insert member and removes the foreign matter adhered to the insert member effectively.

[0022]

In the invention according to claim 6, based on any one of the inventions according to claim 3-5, in the cleaning process, a cleaning apparatus that has a plurality of nozzles is used, wherein the nozzles are arranged substantially along the outer shape of the insert member, and inject the cleaning agent to the insert member.

[0023]

The invention according to claim 6, in addition to the advantages of any one of the inventions according to any one of claims 3 to 5, since the processed insert member in the machining process is cleaned using a cleaning apparatus that has a plurality of nozzles, the cleaning time of the insert member is reduced. Also, since a plurality of nozzles are arranged substantially along the outer shape of the insert member, the entire insert member is almost evenly cleaned.

[0024]

In the invention according to claim 7, based on any one of the inventions according to any one of claims 3 to 6, the cleaning agent is a fluid that is contained in the machining aid used in the machining process, and the fluid contains a substance that dissolves, disperses, or adsorbs an adhesive component causing the foreign matter to adhere to the insert member.

[0025]

For example, the cutting process, which cuts the insert member, is performed in the machining process, while supplying cutting lubricant of the machining aid to portions of the insert member that are being cut. The adhesive component of the cutting lubricant causes shavings of the insert member easily to adhere to the insert member.

[0026]

In contrast, in the invention according to claim 7, in addition to the advantages of any one of the inventions according to any one of claims 3 to 6, the adhesive component used in the machining process is removed from the insert member by the cleaning agent in the cleaning process. At this time, the foreign matter adhered to the insert member is removed with the adhesive component in the machining aid.

[0027]

In the invention according to claim 8, based on the invention according to claim 7, the cleaning process includes injecting the cleaning agent to the insert member at a predetermined pressure.

[0028]

In the invention according to claim 8, in addition to the advantages of the invention according to claim 7, since the injected cleaning agent to the insert member intensely collides against the outer surface of the insert member, the foreign matter adhered to the insert member can be removed more efficiently.

[0029]

In the invention according to claim 9, based on the invention according to claim 7 or 8, when the machining aid has affinity for water, the cleaning agent is water.

[0030]

In the invention according to claim 9, in addition to the advantages of the invention according to claim 7 or 8, since water, which is inexpensive and easily obtainable, can be used as a cleaning agent, the manufacturing cost for the insert member is reduced.

[0031]

In the invention according to claim 10, based on any one of the inventions according to any one of claims 3 to 9, in the cleaning process, a cleaning agent, which is heated to a temperature higher than an ordinary temperature, is used.

[0032]

In the invention according to claim 10, in addition to the advantages of any one of the inventions according to any one of claims 3 to 9, since the cleaning agent itself is high temperature, the ability of the cleaning agent to remove foreign matter is improved. This can remove the foreign matter adhered to the insert member promptly. Moreover, this permits the insert member to be readily dried after finishing the cleaning process.

[0033]

In the invention according to claim 11, based on the invention according to claim 10, the cleaning agent is steam. In the invention according to claim 11, the advantages of the invention according to claim 10 becomes more prominent.

[0034]

In the invention according to claim 12, based on any one of the inventions according to claim 1-11, the insert member is a core of a vehicle steering wheel.

[0035]

In the invention according to claim 12, in addition to the advantages of any one of the inventions according to any one of claims 1 to 11, when molding a vehicle steering wheel, using a cleaned core in the cleaning process prevents the foreign matter from remaining inside the molded steering wheel. This retains a good feel and appearance of the steering wheel, which a driver always contacts with and rotatably controls when driving a vehicle, and which is easily visible by passengers in the vehicle, and prevents degradation in quality.

[0036]

[Embodiments]

A manufacturing method of a vehicle steering wheel as an insert product according to one embodiment of the present invention will now be described with reference to Figs. 1 to 8.

[0037]

As shown in Fig. 1, the steering wheel 10 includes a ring 11, a boss 12, and a plurality of spokes 13 for coupling the ring 11 to the boss 12. (In this embodiment, the number of the spokes 13 is three.) The steering wheel 10 has a core 14 as the insert member. All of the outer surfaces of the core 14 that correspond to the ring 11 and a part of the outer surface of the core 14 that corresponds to the spokes 13 are coated with a molding material such as polyurethane (PUR). On the surface of the mold layer consisting of this mold material, a coating layer (a mold coating layer) that has, for example, light resistance is formed. The coating layer protects the surface of the mold layer.

[0038]

This steering wheel 10 is manufactured by insert molding an insert member of the core 14, which is previously formed into a predetermined shape.
A procedure for manufacturing the core 14 will now be described with reference to Fig. 2.

[0039]

As shown in Fig. 2, for manufacturing the core 14, first, the core 14 is formed in the molding process of step S1. In this molding process, the core 14 is formed through casting. The core 14 may be formed through processes other than casting.

[0040]

Then the processing of the core 14 formed in the molding process proceeds to a machining process of step S2.
In this embodiment, in the machining process, first a finishing process of step S21 is performed. In this finishing process, fins formed on the core 14 during casting are removed and the core 14 is subjected to, for example, shot blasting. Then in a cutting process of step S22, the cutting process is performed to the finished core 14. In the cutting process, threaded holes 15 (see Fig. 1) are formed in the steering wheel 10. The threaded holes 15 are used for fixing an airbag apparatus and a horn switch (neither is shown) to the steering wheel 10. The cutting process is performed while supplying machining aid, or cutting lubricant, to portions of the core

14 that are being cut. As the cutting lubricant, water emulsion type, which can be diluted with water and has affinity for water, is widely used in recent years from the standpoint of environmental protection. In the cutting process, the cutting lubricant that is diluted with water is used.

[0041]

Even if the fins and the threaded holes 15 on the core 14 are at exposed positions that are not covered by the mold layer, the shot blasting process and the cutting process are performed prior to an insert molding process (described below) to prevent the mold layer and the coating layer from being damaged.

[0042]

The cutting lubricant used in the cutting process adheres to the outer surface of the core 14, and adhesive components in water composition and oil component of the cutting lubricant cause the removed fins and the particles of the shot blasting created in the machining process and the shavings created in the cutting process to be adhered to the outer surface of the core 14.

[0043]

Thus, in this embodiment, to remove the cutting lubricant used in the machining process and foreign matter adhered to the outer surface of the core 14 that includes swarf created in the machining process, the core 14 is cleaned in a cleaning process of step S3. In the cleaning process, for example, a cleaning apparatus 20 shown in Figs. 3 to 5 is used. The cleaning apparatus 20 injects the cleaning agent to the core

14.

[0044]

As shown in Figs. 3 and 4, the cleaning apparatus 20 includes cleaning portions 21, a tank 22, a supply pipe 23, and drain pipes 24. The cleaning portion 21 accommodates the core 14. The tank 22 stores the cleaning agent. The supply pipe 23 connects the cleaning portion 21 to the tank 22. The supply pipe 23 has a pump 25 and a motor 26. The pump 25 sends the cleaning agent in the tank 22 to the interior of the cleaning portion 21 and the motor 26 drives the pump 25.

[0045]

In the cleaning apparatus, the cleaning portion 21 has an opening on the top surface through which the core 14 can pass. The opening of the cleaning portion 21 is opened and closed with a door 21a. The door 21a is coupled to the cleaning portion 21 and is moved vertically by a cylinder for opening and closing door 21b. The cleaning portion 21 has an operating switch 21c for operating the cleaning apparatus 20.

[0046]

As shown in Fig. 5, the cleaning portion 21 accommodates a cleaning bath 30 and a lid 31. The cleaning bath 30 has an opening 30a on the upper surface. The lid 31 is movable in the vertical direction with the door 21a, and opens and closes the opening 30a of the cleaning bath 30.

[0047]

The cleaning bath 30 accommodates a slide table 32, a receiving jig 33 located on the slide table 32, and a plurality of nozzle 34. (In this embodiment, the number of the nozzles 34 is sixteen.) The slide table 32 is displaced by a predetermined distance in the cleaning bath 30. The receiving jig 33 is engaged with the core 14. The nozzles 34 inject the cleaning agent to the core 14.

[0048]

In the cleaning apparatus 20, some of the nozzles 34 are attached to a fixing member 35a fixed to the cleaning bath 30. The other nozzles 34 are attached to a fixing member 35b fixed to the lid 31. The fixing members 35a, 35b are connected to the supply pipe 23 (see Fig. 3) and permit the cleaning agent stored in the tank 22 to flow.

[0049]

In the cleaning apparatus 20, the nozzles 34 are arranged along the outer shape of the core 14, which is engaged with the receiving jig 33. Specifically, the nozzles 34 are arranged along the ring portion 14a, the spoke portions 14b, and the boss portion 14c of the core 14.

[0050]

The plurality of nozzles 34 are provided so that the distance L between an injection outlet 34a of each nozzle 34 and the outer surface of the core 14 along the injecting direction of the cleaning agent is between 10 mm and 500 mm inclusive. The range of the distance L is preferably between 10 mm and 100 mm inclusive, and more preferably between 30 mm and 40 mm inclusive. Fig. 5 shows that the distance L when the injection direction of the cleaning agent is in the direction of the center line.

[0051]

In the cleaning process of step S3, the range of the pressure of the cleaning agent injected by the plurality of nozzles 34 is between 0.2 MPa and 0.5 MPa inclusive. The range of the pressure is preferably between 0.2 MPa and 0.4 MPa inclusive, and more preferably, between 0.25 MPa and 0.35 MPa inclusive.

[0052]

In the cleaning process of step S3, the range of the injecting time of the cleaning agent injected by the plurality of nozzles 34 is between two seconds and ten seconds inclusive. The range of the injecting time is preferably between four seconds and eight second inclusive, and more preferably between five seconds and six seconds inclusive.

[0053]

If the distance L is greater than 500 mm, if the pressure is less than 0.2 MPa, or if the injecting time is less than two seconds, cleaning effect of the cleaning agent is not sufficient and foreign matter adhered to the core 14 cannot be satisfactorily removed. To the contrast, if the distance L is less than 10 mm or if the pressure is more than 0.2 MPa, the injection of the cleaning agent is concentrated in narrow areas on the core 14. In this case, it is difficult to evenly clean the entire core 14. If the injecting time exceeds two seconds, the manufacturing time of the core 14 is extended, which increases the cost.

[0054]

In the cleaning process of step S3, a fluid containing substance for dissolving or dispersing the adhesive component in the cutting lubricant is used. In this embodiment, water is used as the fluid.

[0055]

The reason why water is used for the cleaning agent will now be explained.

Experiments were conducted using the core 14 that had finished the machining process of step S2. Specifically, the experiments were conducted for confirming to what extent shavings and shot blast particles adhered to the outer surface of the core 14 can be removed by the following five removing methods. In the experiments, five to ten core 14 were prepared for each method, and whether shavings and shot blast particles remained on the core 14 after performing each removal method was visually evaluated. If no shavings or shot blast particles were found, the core 14 was determined to be "acceptable." If shavings or shot blast particles were found, the core was determined to be "defective." In this manner, the percent defective was checked for each example.

[0056]

(Example)

In this example, water was injected onto the core 14 after the machining process of the step S2 for cleaning the core 14. In the example, an injection apparatus having a single injection nozzle was used, and cleaning was manually performed by a user. The cleaning time was one minute.

[0057]

(Comparison Example 1)

In this example, the core 14, which had finished the machining process, was cleaned by injecting naphthenic cleaning agent (Naphthesol). The injecting apparatus, the cleaning method, and the cleaning time of this example were the same as those of the above embodiment.

[0058]

(Comparison Example 2)

In this example, the core 14, which had finished the machining process, was cleaned by injecting the same cleaning lubricant as used in the machining process. The injecting apparatus, the cleaning method, and the cleaning time of this example were the same as those of the above embodiment.

[0059]

(Comparison Example 3)

In this example, air was blown to the core 14, which had finished the machining process. In this example, an injection apparatus having a single injection nozzle was used, and air was blown manually by a user. The blowing time was one minute.

[0060]

(Comparison Example 4)

In this example, the surface of the core 14, which had finished the machining process, was scrubbed with a steel scrub brush.

[0061]

The test results of these examples will now be described with reference to chart 1. In chart 1, "O" represents a case where the percent defective was less than 1%, "Δ" represents a case where the percent defective was equal to or more than 1% and less than 10%, and "x" represents a case where the percent defective was in a range between 10% and 100% inclusive.

[0062]

Table 1

Removing Method	Shavings	Shot Blasting Particles

Example	Water Cleaning	○	○
Comparison Example 1	Naphthesol	×	×
Comparison Example 2	Cutting Lubricant	△	×
Comparison Example 3	Air Blow	×	×
Comparison Example 4	Steel Scrub Brush	×	×

In the Naphthesol cleaning of the comparison example 1, the percent defective regarding shavings was 50%, and the percent defective regarding shot blasting particles was 20%. The results were therefore unsatisfactory. This is because the naphthenic cleaning agent is capable of removing the oil component in the cutting lubricant adhered to the core 14 but is not effective to remove the aqueous component in the cutting lubricant. Therefore, the aqueous component remaining on the outer surface of the core 14 prevented shavings and shot blasting particles from being removed.

[0063]

In the cutting lubricant cleaning of the comparison example 2, although the percent defective regarding shavings was relatively good 4%, the percent defective regarding shot blasting particles was 100%. This shows that relatively large foreign matter such as shavings was removed, while small foreign matter such as shot blasting particles was not removed.

[0064]

In the air blow of the comparison example 3, the percent defective regarding shavings was 60%, and the percent defective regarding shot blasting particles was 40%. The results were therefore unsatisfactory.

[0065]

In the scrubbing with a steel scrub brush of the comparison example 4, the percent defective regarding shavings was 50%, and the percent defective regarding shot blasting particles was 40%. The results were therefore unsatisfactory. Also, in the comparison example 4, scrubbing the surface of the core 14 with the steel scrub brush shaved the outer surface of the core 14 and created fine powder.

[0066]

Compared to the comparison examples 1 to 4, in the water cleaning according to the embodiment, the percent defective was 0% for both shavings and shot blasting particles. That is, the results show a very high removal effect. The cutting lubricant used in the cutting process can be diluted with water and has affinity for water. Therefore, the aqueous component of the cutting lubricant on the core 14 was dissolved with water injected in the cleaning process, and the oil component was dispersed. This reduces the adhesion of the aqueous component and adhesive component of the oil component of the cutting lubricant on the core 14, and hinders foreign matter such as shavings and shot blasting particles from being removed from the core 14. In this manner, water cleaning of the core 14 in the cleaning process effectively removes foreign matter collected on the core 14. Also, since water is inexpensive and has little adverse effect on the environment, using water as the cleaning agent is preferable.

[0067]

As shown in Fig. 2, a drying process of step S4 is performed after the cleaning process of step S3. In the drying process, cleaning agent, which removes water adhered on the core 14 in the cleaning process, is removed. In this embodiment, in the cleaning process, air is blown to the core 14 in the cleaning portion 21 of the cleaning apparatus 20. Thereafter, the core 14 is removed from the cleaning apparatus 20 and is left unattended for about a half-day.

[0068]

The core 14 thus produced through each of the above processes is provided for manufacturing the steering wheel 10 by using a manufacturing apparatus described below.

[0069]

The manufacturing apparatus 40 for manufacturing a steering wheel 10 using the core 14 produced as described above will now be described with reference to Figs. 6 and 7. As shown in Figs. 6 and 7, the manufacturing apparatus 40 includes a mold 41, coating material injection device 55, molding material injection device 56, and a decompression device 60. The coating material injection device 55 is used for forming the coating layer. The molding material injection device 56 is used for forming the mold layer. The decompression device 60 is used for decreasing the pressure in the cavity 42 of the mold 41.

[0070]

The mold 41 is provided in a box 45 having a frame body 43 and a lid body 44. A stationary die 46 forming the mold 41 is located in the frame body 43. A movable die 47 forming the mold 41 is located in the lid body 44. The lid body 44 has a sealing member 44a at a position that contacts the frame body 43.

[0071]

In the manufacturing apparatus 40, when the lid body 44 is moved upward relative to the frame body 43 (moved upward as viewed in Fig. 6) and parts of the frame body 43 contacting the lid body 44 are spaced apart from each other, parting surfaces of the movable die 47 and the stationary die 46 are spaced apart from each other, and the mold 41 is opened. In contrast, when the lid body 44 is moved toward the frame body 43 and the contacting parts of the frame body 43 and the frame body 43 contact each other, the parting surfaces of the movable die 47 and the stationary die 46 contact each other and the mold 41 is clamped. When the mold 41 is clamped, the frame body 43, the lid body 44, and the sealing member 44a seal the space 45a in the box 45.

[0072]

An annular groove 46a is formed on the parting surface of the stationary die 46. An annular groove 47a is also formed on the parting surface of the movable die 47 that corresponds to the groove 46a on the stationary die 46. Radial portions 46b, 47b are formed at positions (3 positions in this case) of the annular grooves 46a and 47a that correspond to the spokes 13 of the steering wheel 10. The radial portions 46b, 47b face substantially toward the center of the annulus ring. When the mold 41 is clamped, the annular grooves 46a, 47a define the cavity 42 for molding the steering wheel 10.

[0073]

An injection groove 46c is formed in the parting surface of the stationary die 46. The injection groove 46c extends outward from the annular groove 46a and is forked into two branches at one point. In the movable die 47, a two-forked injection groove 47c is also formed in a position that corresponds to the injection groove 46c of the stationary die 46. The injection grooves 46c, 47c form a gate 41a when the mold 41 is clamped. The cavity 42 of the mold 41 and the exterior of the box 45 are communicated by the gate 41a and two openings 48 formed in the frame body 43.

[0074]

A vent 49 having a small diameter is formed in movable die 47. The vent 49 opens at the outer surface of the movable die 47 and at the inner bottom surface of the annular grooves 47a. The vent 49 is formed at a position that is farthest from the gate 41a. A through hole 50 is formed in movable die 47. The through hole 50 opens at the outer surface of the movable die 47 and at the inner bottom surface of the radial portions 47b of the annular grooves 47a. The through hole 50 may be omitted.

[0075]

The coating material injection device 55 is a device to inject coating material as a solution including molding material for forming the coating layer of the steering wheel 10 into the cavity 42 of the mold 41. The coating material contains mold coating agent (for example, light-resistant polyurethane), colorant, and solvent. The mold coating agent is a solid matter of molding material, and the solvent is a molding assistant such as methyl ethyl ketone (MEK) and isopropyl alcohol (IPA).

[0076]

On the other hand, the molding material injection device 56 is a device to inject molding material for forming the mold layer of the steering wheel 10 into the cavity 42 of the mold 41. The molding material contains polyol component and isocyanate component, which react with each other to form polyurethane.

[0077]

When manufacturing the steering wheel 10, the decompression device 60 is a device to decrease the pressure of the space 45a of the box 45 and the pressure of the cavity 42 of the mold 41 and has a vacuum pump 61. The vacuum pump 61 is connected to the frame body 43 through a supply pipe 62 and a discharge pipe 63. A valve 64 is provided in the supply pipe 62.

[0078]

A procedure for manufacturing the steering wheel 10 using the manufacturing apparatus 40 will now be described with reference to Fig. 8. The steering wheel 10 is manufactured, for example, through the insert molding process described below.

[0079]

In the insert molding process, first in a coating forming process of step S5, a mold release agent is applied to the inner bottom surface of the annular groove 46a of the stationary die 46 and the inner bottom surface of the annular groove 47a of the movable die 47 using, for example, a spray gun, when the mold 41 is opened. Accordingly, a film of the mold release agent is formed on the inner bottom surface of each of the annular groove 46a, 47a. The mold release agent is, for example, wax or silicone oil. The mold release agent prevents the molded steering wheel 10 from adhering to the mold 41, and facilitates removal of the steering wheel 10.

[0080]

Subsequently in step S6, the core 14, which has been manufactured by the above described manufacturing method, is set at a predetermined position in the stationary die 46. Then, the mold 41 is clamped. At this time, the lid body 44 contacts the frame body 43 and the box 45 is sealed.

[0081]

Then, in a coating forming process of step S7, a coating layer such as a mold coating material is formed on the film of the mold release agent. In the coating forming process of the mold coating material, the coating material injection device 55 injects a predetermined amount of coating material into the cavity 42 of the mold 41 through the gate 41a. Thereafter, the vacuum pump 61 is activated to decrease the pressure of the space 45a of the box 45 and the pressure of the cavity 42 of the mold 41. When the pressure in the cavity 42 is decreased to a predetermined pressure, the solvent in the coating material injected in the cavity 42 comes to a boil. Boiling of the solvent causes the molding material and the colorant to be evenly applied onto the inner wall surface of the cavity 42 (specifically, on the film of the mold release agent). The vaporized solvent is discharged to the outside of the box 45 through the vent 49, the through hole 50, and the decompression device 60 from the cavity 42. This dries the cavity 42, and forms a coating layer (mold coating layer) having an even thickness on the inner wall surface (the film of the mold release agent) of the cavity 42.

[0082]

Subsequently, in a urethane molding process of step S8, the mold layer is formed. In the urethane molding process, the molding material injection device 56 injects a predetermined amount of molding material into the cavity 42 of the clamped mold 41 through the gate. That is, a conventional urethane molding is performed. After the urethane molding process, the mold 41 is opened to remove the steering wheel 10 in which the mold layer is filled between the coating layer and the core 14.

[0083]

Accordingly, the present embodiment provides the following advantages.

(1) In the present embodiment, during manufacturing of the core 14, the core 14 is cleaned in the cleaning process (step S3) after the finishing process (step S21) and the cutting process (step S22). These processes are performed prior to the insert molding process.

[0084]

Therefore, even foreign matter such as cutting lubricant and swarf (shavings and shot blasting particles) adhered to the surface of the core 14 during the finishing process and the cutting process, the foreign matter is removed from the core 14 in the cleaning process. This prevents the foreign matter from remaining in the mold layer and the coating layer of the molded steering wheel 10. This prevents the quality of the appearance or feel of a steering wheel, which a driver always contacts with and rotatably controls when driving a vehicle, and which is easily visible by passengers in the vehicle, from deteriorating.

[0085]

Particularly, as the present embodiment, in a case where the coating layer is formed using boiling of the solvent containing the coating material in the coating forming process of the mold coating material (step S7), the foreign matter adhered to the surface of the core 14 falls when the solvent boils and is apt to move onto the inner wall surface of the cavity 24 (the film of the mold release agent). If the insert molding process is performed in this state, in which the foreign matter may fall, the fallen foreign matter is apt to remain on the outer surface of or in the vicinity of the surface of the molded steering wheel 10, which degrades the quality of the steering wheel 10.

[0086]

On this point, in the present embodiment, the fallen foreign matter does not remain on the outer surface of or in the vicinity of the surface of the molded steering wheel 10, and the degradation in the quality of the steering wheel 10 is avoided.

[0087]

(2) In the cleaning process, the core 14 is cleaned with water. In the cutting process, a cutting lubricant which has affinity for water is used. Water is a fluid that is capable of dissolving or dispersing the aqueous component or adhesive component such as the oil component in the cutting lubricant. Therefore, the adhesive component in the cutting lubricant used in the machining process is dissolved or dispersed with water used in the cleaning process, thereby removing the adhesive component from the core 14. Accordingly, the foreign

matter such as swarf adhered to the core 14 is removed with the adhesive component. Since water is inexpensive and widely available, and has little adverse effect on the environment, the manufacturing cost of the core 14 is reduced.

[0088]

(3) The cleaning process is performed by injecting water to the core 14 with a predetermined pressure. Therefore, when cleaning the core 14 in the cleaning process, injected water intensely collides against the outer surface of the core 14, and the collided water effectively remove the foreign matter adhered to the core 14.

[0089]

(4) In the cleaning process, a cleaning apparatus 20, which has a plurality of nozzles 34, is used. The plurality of nozzles 34 are arranged substantially along the outer shape of the core 14 and inject water to the core 14. Since the cleaning apparatus 20, which has the plurality of nozzles 34, is used for cleaning the core 14, the time required for cleaning the core 14 is reduced. Also, in the cleaning apparatus, since the plurality of nozzles 34 are arranged substantially along the outer shape of the core 14, the entire core 14 is evenly cleaned.

[0090]

(5) After the cleaning process, the drying process (step S4) is performed for drying and removing water adhered to the core 14. Therefore, for example, if water is used as a foaming agent and foamed in the urethane molding process (step S8), the foaming agent will not be excessive, and the foaming state of the mold layer of the steering wheel 10 will be in a

desired manner.

[0091]

[Modifications]

The present invention may be modified as follows. In the present embodiment, in the cleaning process (step S3), the temperature of water used for cleaning the core 14 is arbitrarily determined.

[0092]

In the cleaning process, if water that is heated to a temperature higher than an ordinary temperature is used, the ability of water to remove the foreign matter is improved. Accordingly, the foreign matter adhered to the core 14 is readily removed. Also, heated water increases the temperature of the core 14 at the end of the cleaning process, which improves the drying of the core 14. Particularly, using steam to clean the core 14 will make these advantages remarkable.

[0093]

In the present embodiment, the cleaning agent used in the cleaning process is not limited to water. The cleaning agent may be changed appropriately depending on the machining aid used in the machining process (step S2).

[0094]

The cleaning agent is not limited to one that can dissolve or disperse the adhesive component in the cutting lubricant used in the machining process. The cleaning agent may be a fluid that contains a substance that dissolves, disperses, or adsorbs an adhesive component in the machining aid.

[0095]

The cleaning agent is not limited to liquid, but may be, for example, gas or powder fluid.
In the present embodiment, the number, the arrangement, and the injection manner of the nozzles 34 in the cleaning apparatus 20 may be changed appropriately according to the shape and the size of the core 14.

[0096]

In the present embodiment, in the cleaning process, the cleaning is not necessarily performed by the cleaning apparatus 20. For example, the core 14 may be immersed in and caused to contact a cleaning agent stored in a container to remove the foreign matter adhered to the core 14. Even in this manner, the foreign matter adhered to the core 14 is efficiently removed. In this case, with the core 14 immersed in the cleaning agent, moving the core 14 or stirring the cleaning agent permits the foreign matter adhered to the core 14 to be efficiently removed.

[0097]

In the present embodiment, processes performed in the machining process are not limited to the shot blasting process and the cutting process. As long as the machining process includes machining that is performed using an adhesive material (for example, processed oil of various types or water), the types, the number, and the order of processes may be arbitrarily determined.

[0098]

In the present embodiment, for example, if using the core 14 with cleaning agent adhered to the outer surface in the insert molding process does not affect the quality of the steering wheel 10, the drying process (step S4) may be omitted.

[0099]

In the present embodiment, the types and the order of processes in the insert molding process (steps S5 to S8) are not limited to those described above. For example, when molding a leather covered steering wheel, which does not require the coating layer, the coating forming process of the mold coating material (step S7) may be omitted.

[0100]

While the present embodiment illustrates an example method of manufacturing the steering wheel 10, the present invention may be applied to insert molded products other than the steering wheel 10. For example, the present invention may be applied to a method for manufacturing assist grips.

[0101]

Furthermore, the technical ideas from the present embodiment and the above descriptions will be described with the advantages below.

(A) A cleaning apparatus for an insert member is characterized by having a cleaning bath and a plurality of nozzles. The cleaning bath accommodates the insert member used as an insert molding product. The plurality of nozzles inject a cleaning agent to the insert member, and are arranged substantially along the outer shape of the insert member.

[0102]

According to the invention described in (A), the same advantages as claim 6 are achieved.

[0103]

[Effects of the Invention]

As described above, the invention according to claim 1, 2, or 12 prevents degradation of the appearance or feel and the quality of the insert mold product.

[0104]

In the invention according to claim 3, in addition to the advantages of the invention according to claim 1 or 2, the foreign matter adhered to the insert member can be removed effectively.

[0105]

In the invention according to claim 4, in addition to the advantages of the invention according to claim 3, the negative effect of the cleaning agent to the quality of insert mold product can be avoided.

[0106]

In the invention according to claim 5 or 8, in addition to the advantages of the invention according to claim 3, 4 or 7, the foreign matter adhered to the insert member can be removed effectively.

[0107]

In the invention according to claim 6, in addition to the advantages of any one of the inventions according to claim 3-5, the cleaning time of the insert member can be reduced. Accordingly, the entire insert member is almost evenly cleaned.

[0108]

In the invention according to claim 7, in addition t the advantages of any one of the inventions according to claim 3-6, the foreign matter adhered to the insert member can be removed with the adhesive component in the machining aid.

[0109]

In the invention according to claim 9, in addition to the advantages of the invention according to claim 7 or 8, the manufacturing cost for the insert member can be reduced.

In the invention according to claim 10 or 11, in addition to the advantages of any one of the inventions according to claim 3-10, the drying of the insert member can be improved after finishing the cleaning process.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] A perspective view illustrating a vehicle steering wheel according to one embodiment of the present invention.

[Fig. 2] A flowchart showing a procedure for manufacturing a core.

[Fig. 3] A front view illustrating a schematic representation of a cleaning apparatus used in a cleaning process.

[Fig. 4] A schematic side view showing the cleaning apparatus.

[Fig. 5] A cross-sectional view taken along line 5-5 in Fig. 3.

[Fig. 6] A diagram showing a schematic representation of a manufacturing apparatus of a vehicle steering wheel.

[Fig. 7] A cross-sectional view illustrating a schematic representation of a box and mold of the manufacturing apparatus.

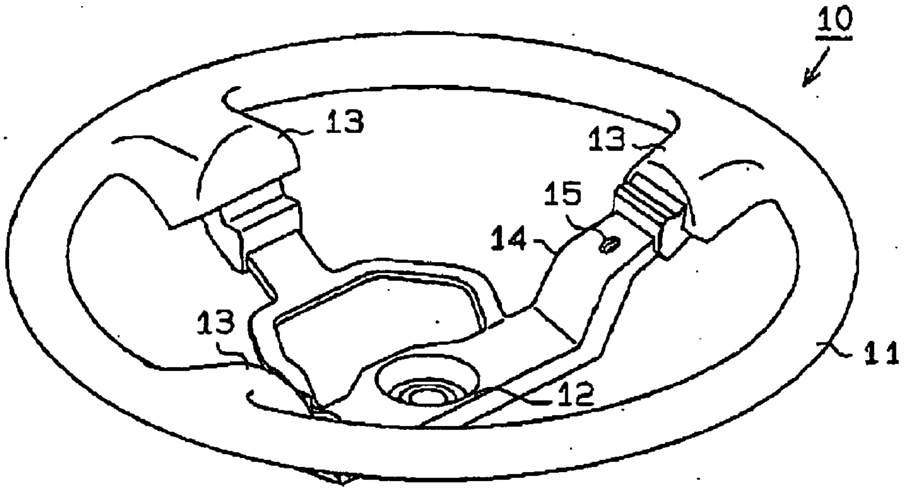
[Fig. 8] A flowchart showing a procedure for manufacturing the vehicle steering wheel.

[Description of the Reference Numerals]

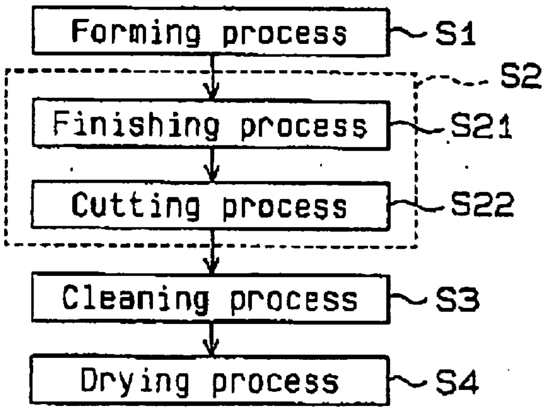
10…steering wheel as a molding product, 14…core as an insert member, 20…cleaning agent, 30…cleaning bath, 34…nozzle, 34a…injection outlet, 41…core as an insert mold, 42…cavity.

[Title of Document] Drawings

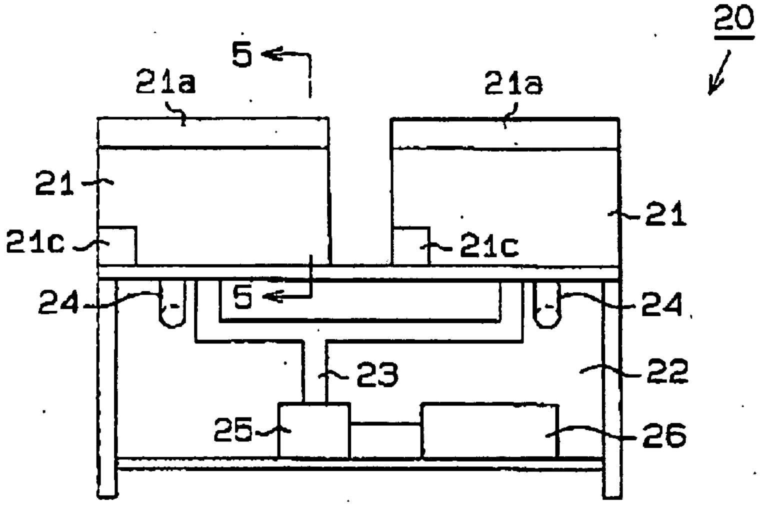
[Fig. 1]



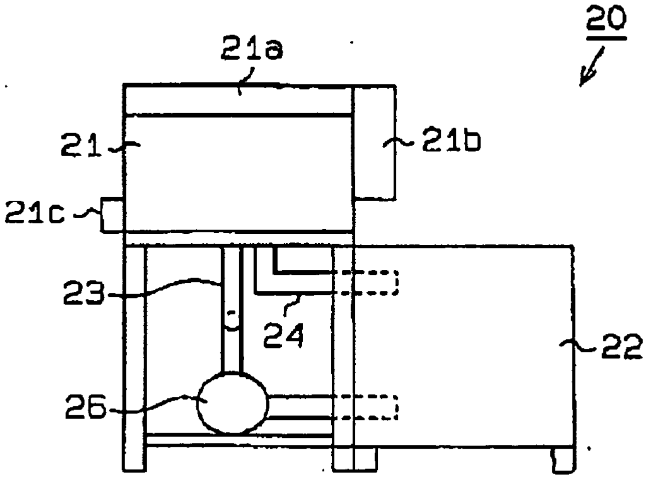
[Fig. 2]



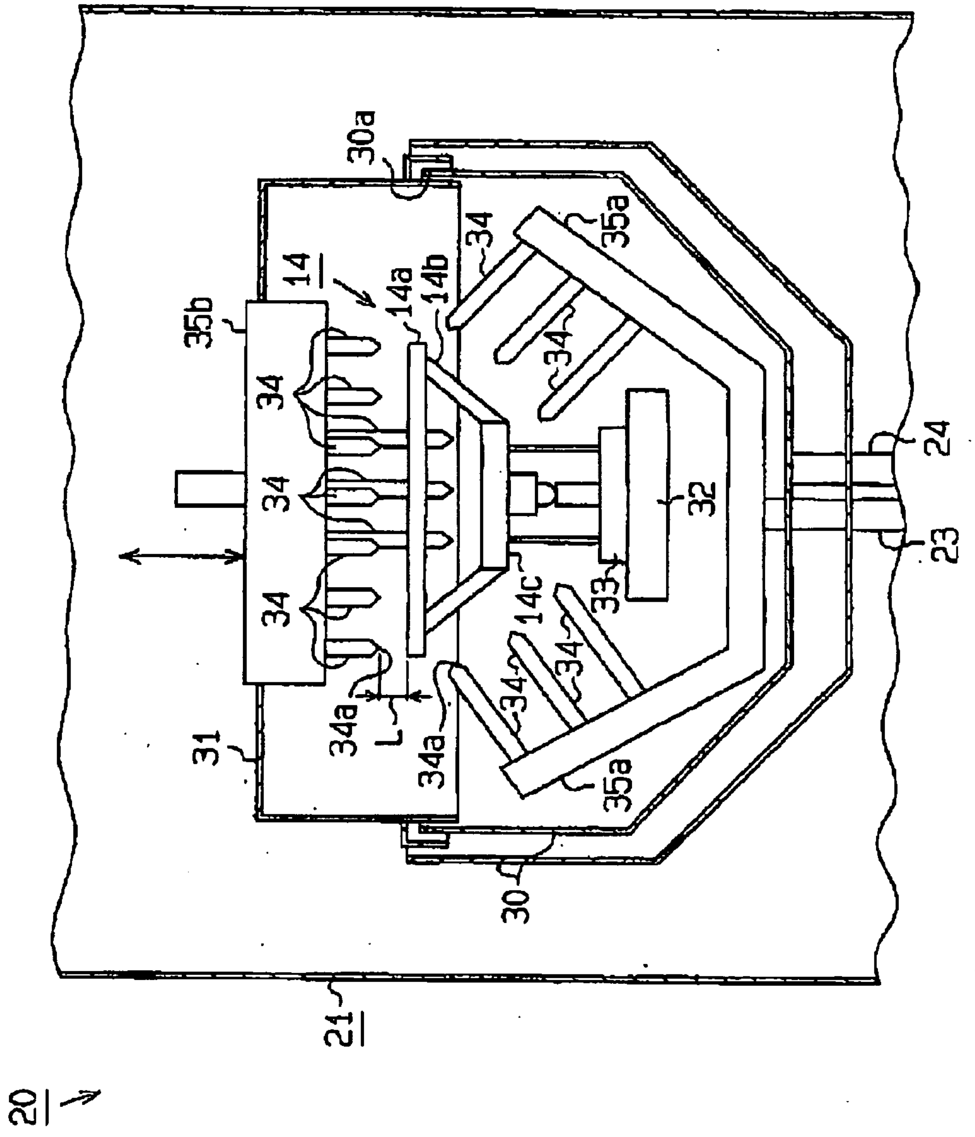
[Fig.3]



[Fig.4]



[Fig.5]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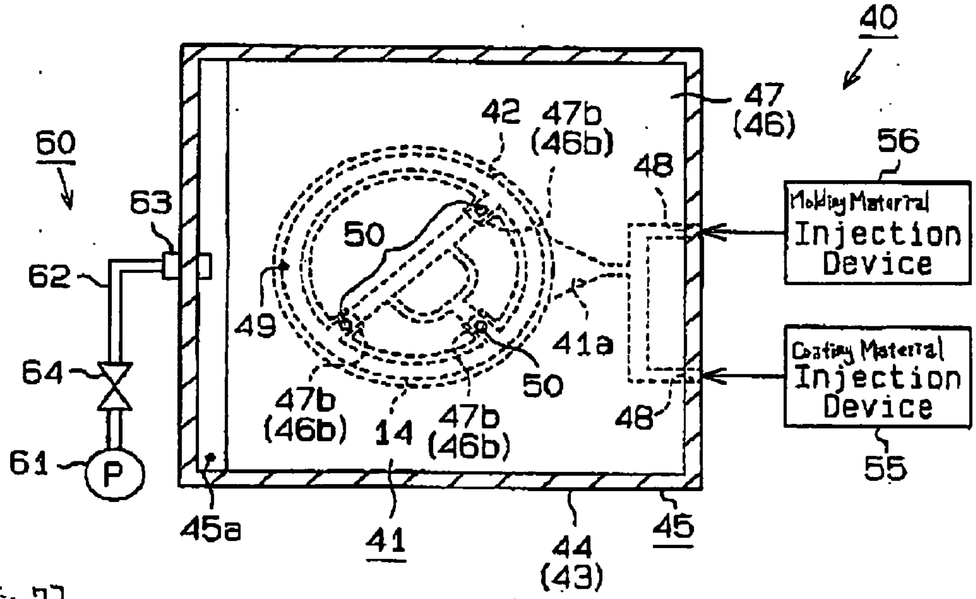
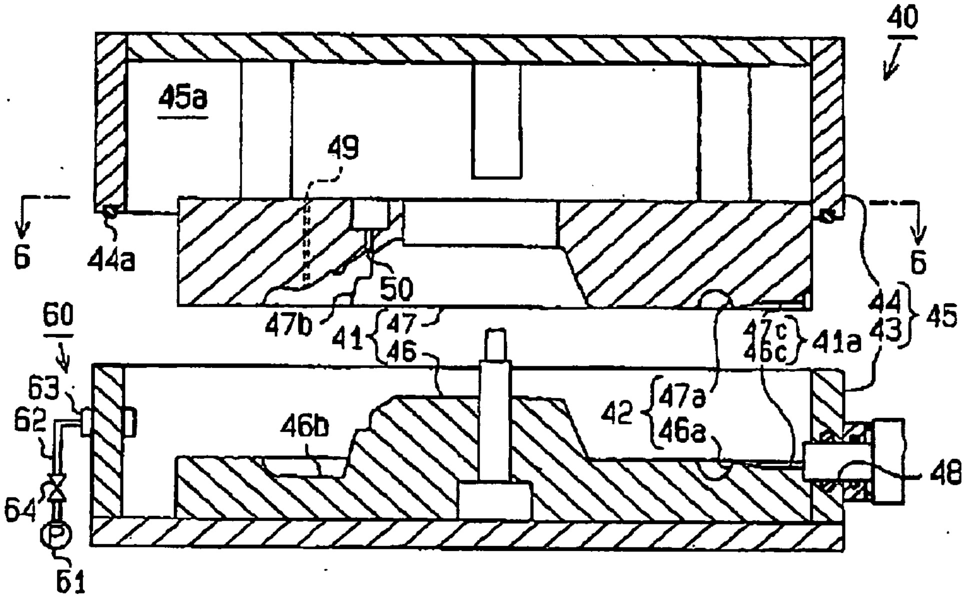
[Fig. 6]


(46)
(46b)
Molding Material
Injection Device
(46b)
(46b)
Coating Material
Injection Device
P
(43)

[Fig. 7]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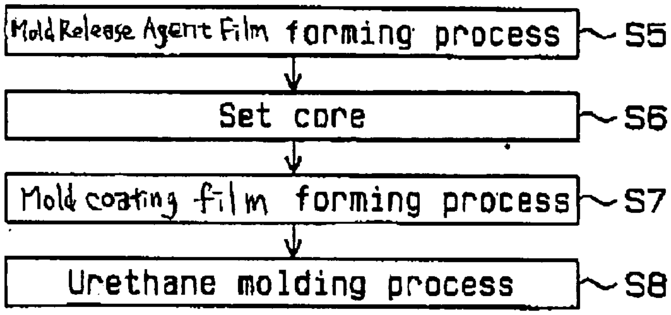
[Fig.8]


Mold Release Agent Film forming process
S5
Set core
S6
Mold coating film forming process
S7
Urethane molding process
S8

[Title of Document] Abstract

[Abstract]

[Problem to be solved]

The present invention provides a method for manufacturing an insert mold product, which prevents degradation in the quality of the insert mold product.

[Solution]

Shot blasting is performed to the core, which is molded through casting, in the machining process (step S21) to remove the fins. Subsequently, threaded holes are formed on the core in the machining process. Thereafter, in the cleaning process (step S3), water is injected to the core to remove the foreign matter such as the cutting lubricant or the shot blasting particles adhered to the outer surface of the core. Finally, in the drying process (step S4), water adhered to the outer surface of the core is dried. A steering wheel is manufactured using the core formed through these processes.

[Selected Drawing] Fig. 2